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Density functional theory simulation of liquid helium-4 in aerogel

Lysogorskiy Y., Tayurskii D.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The distribution of liquid 4He in different types of confinements-adsorbing and nonadsorbing aerogel on the basis of silicon dioxide SiO2 and an absorbing homogeneous strand-has been studied using the density functional theory. It has been demonstrated that the helium atoms tend to be adsorbed on the concave aerogel surface. It has been shown that, in the confinement with fractional mass dimension within certain scales, liquid helium also has a fractional mass dimension within these scales. The dependence of the energy of liquid helium on the number of atoms has been studied for different types of adsorbing surfaces. It has been established that the specific energy of liquid helium behaves differently in the cases of attractive and unattractive potentials with decreasing number of particles. This indicates that the system under consideration is nonextensive. Thus, the necessity of taking into account the surface effects and the fractional mass dimension in the studies of the properties of liquid helium in the restricted space geometry has been demonstrated. © 2013 Pleiades Publishing, Inc.

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